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Efficacy of Serum Albumin against Pre Operative American Association of Anesthesiologists (Asa) Grade and Hematocrit As Pre Operative Risk Predictors

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ABSTRACT
Background: Studies have shown that patients who had lower serum albumin levels showed a trend towards having higher postoperative mortality rates and had significantly higher rates of several complications than did patients with higher serum albumin levels, while controlling for other risk factors. To compare its efficacy against pre operative American Association of Anesthesiologists (ASA) grade and Hematocrit as risk predictors, the present study was conducted.
Methods: The present study is a retrospective observational case control study comprising of 100 patients. The 50 patients who developed post operative complications within 30 days of the procedure comprise the case study groups, rest 50 form the control group. To see the association between the variables (risk predictors) and the presence of post operative complications, P value is calculated to determine statistical significance.
Results: Association of serum albumin with post operative complications is statistically significant. Association was found between hematocrit and post operative complications but not with ASA grade. **Conclusion**: Pre-operative hypoalbuminemia can be used as both an independent predictive factor for post-operative complications and as prognostic parameter regarding overall survival in post operative period. Association was found between hematocrit and post operative complications but not with ASA grade.
Keywords: Hypoalbuminemia; Predictive factor; ASA; Hematocrit

I. INTRODUCTION

Albumin is a better prognostic indicator than anthropomorphic markers of nutritional status because of its ability to detect protein-energy malnutrition, which is not necessarily accompanied by lower body weight and may not be clinically recognizable, but is associated with significantly increased risk of morbidity and mortality. Recently, studies have shown that patients who had lower serum albumin levels showed a trend towards having higher postoperative mortality rates and had significantly higher rates of several complications than did patients with higher serum albumin levels, while controlling for other risk factors.

Gibbs et al. reported in 1999 that out of some 61 preoperative patient risk variables, albumin was the strongest predictor of mortality and morbidity for surgery as a whole and within several surgical subspecialty areas. They observed that a decrease in Serum Albumin from concentration greater than 4.6 g/dl to less than 2.1 g/dl ($p<0.001$) was associated with exponential increase in morbidity and mortality and that it was a good prognostic indicator, whereas anthropometric markers could not predict postoperative outcome.[1]

Albumin also has been found to predict postoperative mortality and morbidity for patients undergoing elective surgery[2] and postoperative morbidity for those undergoing gastrointestinal tract surgery. Kudsk et al. evaluated the significance of progressively decreasing preoperative serum albumin concentrations in 526 surgical patients who subsequently underwent elective esophageal, gastric, pancreaticoduodenal or colon surgery. They found when all cases were grouped that the incidence of postoperative complications increased progressively as serum albumin concentrations decreased with a group average of 9 percent complications with a serum albumin concentration of 4.25 g/dL up to 54 percent when serum albumin was at 1.75 g/dL. Complication rates in patients undergoing esophageal and pancreatic procedures, however, were significantly more influenced by low serum albumin concentrations.

More recently, researchers at Vanderbilt developed a nomogram incorporating preoperative serum albumin to predict 90-day survival after RC

in 169 elderly patients. In a set of preoperative variables similar to those presented here, age and preoperative serum albumin were the most significant predictors of 90-day mortality in univariate models. In multivariate Cox regression modeling, preoperative serum albumin was the most significant predictor of 90-day mortality (OR 1.40–4.45).[3]

Hypoalbuminemia has been shown to be associated with increased mortality and morbidity rates in both hospitalized patients[4-7] and samples of community-dwelling elderly persons.[8,9]

The ASA physical status classification system is a system for assessing the fitness of patients before surgery. In 1963 the American Society of Anesthesiologists (ASA) adopted the five-category physical status classification system; a sixth category was later added. These are:

- Healthy person.
- Mild systemic disease.
- Severe systemic disease.
- Severe systemic disease that is a constant threat to life.
- A moribund person who is not expected to survive without the operation.
- A declared brain-dead person whose organs are being removed for donor purposes.

To compare its efficacy against pre operative American Association of Anesthesiologists (ASA) grade and hematocrit as risk predictors, the present study was conducted.

II. MATERIALS AND METHODS

The present study is a retrospective observational case control study comprising of 100 patients. 50 cases and 50 control. All patients undergoing major clean surgical procedures – General Surgery, Oncosurgery, Neurosurgery, Urosurgery, Plastic Surgery, Cardio thoracic Surgery in a tertiary care hospital were included in the study with their due consent for participation in the study. The 50 patients who developed post operative complications within 30 days of the procedure comprise the case study groups, rest 50 form the control group comprising of the patients undergoing the above mentioned procedures but not developing complications.

All patients undergoing major clean surgical procedures (ASA I-V) – General Surgery, Oncosurgery, Neurosurgery, Urosurgery, Plastic Surgery, Cardio thoracic Surgery, patients >12 years and < 70 years of age, with no history of previous surgery in last 1 year and whose Serum Albumin levels measured not more than 30 days before surgery were included in the study.

Patients with loss of weight more than 10 kgs in 6 months prior to surgery, HIV positive patients, patients taking steroids, or on radiotherapy, patients with liver disease/ nephrotic syndrome/ CCF/ IHD/ chronic respiratory disease and surgeries with infective etiology were excluded from the study.

A statistical analysis of the pre operative data as a part of pre anesthesia checkup was done. All the significant pre operative parameters and post operative complications were documented in the proforma. The data was compiled and tabulated to determine the association between the variables (risk predictors) and the presence of complications. P value was calculated to evaluate serum albumin level as a predictor of operative mortality and morbidity in relation to two other variables which are established predictors of post op complications, i.e. ASA grade and hematocrit.

III. RESULTS

Total 100 patients are there in the study group. Out of which, 50 patients who developed post operative complications, are in the case group and 50 patients who did not develop complications, were included in the control group.

There were 48 female and 52 male patients. The mean age group in case study group was 48.24 years with standard deviation of 15.715 years. The mean age group in control group was 48.28 years with standard deviation of 17.075 years.

In 50 cases of post operative complications, 39 patients had hypoalbuminemia, 36 had high risk ASA grade i.e. III-V and 21 patients had low hematocrit. There was presence of more than one risk factors in a single patient, hence these risk factors have been used analysed as independent variables. In all of these, hypoalbuminemia was most prominent followed by ASA grade and hematocrit as a variable in risk prediction. (Figure 1)

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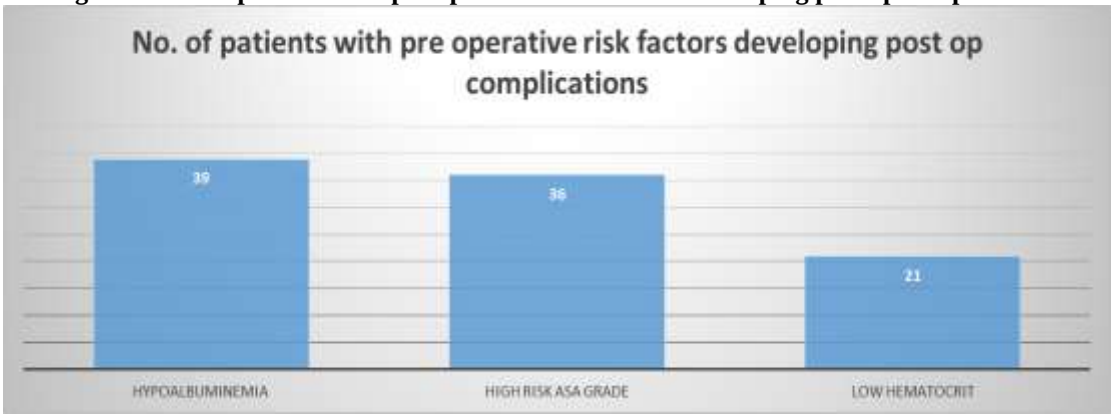
Figure 1: No. of patients with pre operative risk factors developing post op complications



The highest frequency of incidence of complications was in the order of wound dehisence, surgical site infections, prolonged hospital stay and septicemia.

Figure 2 is a comparative depiction of the presence of the risk factors in the patients developing the mostly commonly observed post op complications. When compared, it is evident in this graph that in the patients who developed post operative complication, there was higher incidence of hypoalbuminemia in them, followed by high rish ASA grade and Hematocrit.

Figure 2: Risk factor contribution in various complications

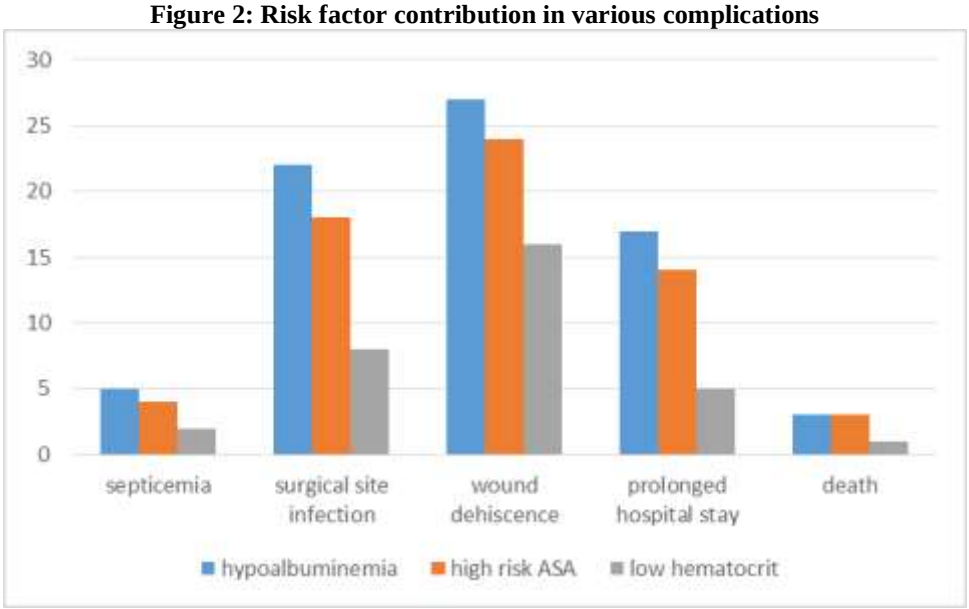


Table 1 suggests that in the presence of complications, there are 1.86 times odds of patient having ASA grade III or >III.

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Table 1: Association between ASA grades and post operative complications

ASA grade	Complications absent	Complications present	
<III (low risk)	21	14	35
III & > III (high risk)	29	36	65
	50	50	100

ODD'S RATIO= 1.86

Table 2 suggests that in the presence of complications, there are 0.34 times odds of patient having hematocrit lower than the normal limit. There are higher odds of developing complications with hypoalbuminemia (Odds ratio 3.72) followed by high risk ASA grade (Odds ratio 1.86) and low hematocrit (odds ratio 0.34).

Table 2. Association between Haematocrit and post operative complications

Haematocrit	Complications absent	Complications present	
36- 46% (low risk)	16	29	45
<36% (high risk)	34	21	55
	50	50	100

ODD'S RATIO= 0.34

p value for ASA distribution for cases and controls is 0.142 which is suggestive of no stastical relation between ASA grade and adverse surgical outcomes as p value >0.05 is stastically not significant. (Table 3)

Table 3: Pearson Chi square test (p value for ASA distribution for cases and controls)

ASA distribution					
			ASA risk group		Total
			III, IV, V High risk	I,II Low risk	
Group	Case	Count	14	36	50
		% of Total	14.0%	36.0%	50.0%
	Control	Count	21	29	50
		% of Total	21.0%	29.0%	50.0%
Total		Count	35	65	100
		% of Total	35.0%	65.0%	100.0%
Chi-Square Test					
	Value	df	P value		
Pearson Chi-Square	2.154[a]	1	.142		

P value for hematocrit level in cases and control is 0.005 which is suggestive of stastical relation between hematocrit and adverse surgical outcomes as p value <0.05 is stastically significant. (Table 4)

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Table 4: Pearson Chi square test (p value for hematocrit level in cases and controls)

Haematocrit Distribution					
			Haematocrit range group		Total
			High	Low	
Group	Case	Count	29	21	50
		% of Total	29.0%	21.0%	50.0%
	Control	Count	15	35	50
		% of Total	15.0%	35.0%	50.0%
Total		Count	44	56	100
		% of Total	44.0%	56.0%	100.0%
Chi-Square Test					
	Value	df	P value		
Pearson Chi-Square	7.955[a]	1	.005		

A detailed analysis of association of these independent variables with duration of hospital stay is suggestive of association of serum albumin with the duration of stay. The mean stay was found to be 8.19 days and p value was calculated to be 0.022 which is statistically significant. (Table 5)

Table 5: Analysis of association of independent variables with duration of hospital stay

Days of hospital stay						
ASA risk group	N	Mean	Std. Deviation	t value	df	P value
Low risk	35	7.26	2.454	-1.354	98	.179
High risk	65	8.00	2.698			

Days of hospital stay						
Albumin range group	N	Mean	Std. Deviation	t value	df	P value
Normal range	36	6.94	2.083	-2.321	98	.022
Low	64	8.19	2.805			

Days of hospital stay						
Haematocrit range group	N	Mean	Std. Deviation	t value	df	P value
Normal range	44	7.91	2.622	.569	98	.571
Low	56	7.61	2.647			

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IV. DISCUSSION

Surgical decision-making has evolved over time from what was once little more than personal experience and intuition. However, in some situations this may become so complex that the decision-making process itself can be as challenging as the technical aspects of the surgery. All surgical procedures have complications, which may be considered to be a necessary occupational risk for surgeons. By surgical risk, we mean the risk of major morbidity and mortality to the patient in the perioperative period. Yet risk to both the patient and surgeon is relative.

In an early series of 26 patients, most operated on for diseases of the digestive tract, Jones and Eaton[10] found that postoperative edema was associated with low concentrations of serum albumin and serum protein, which they attributed to preoperative and postoperative undernutrition.

Reinhardt et al. [6] reviewed the hospital courses of 2060 veterans and found the 30 day mortality in 1551 patients with a normal serum albumin concentration to be 1.7 percent. In contrast, in 509 patients with serum albumin concentrations less than 3.5 g/100 ml, a death rate of 24.6 percent was found. A linear relationship between the degree of hypoalbuminemia and hospital mortality was found. No attempt was made in this study to segregate patients by diagnosis or severity of illness on admission.

Even when patients are segregated by type of surgery or stress, albumin remains a strong predictor of outcome. Rich et al[7] found that patients undergoing cardiac surgery who had lower serum albumin levels showed a trend toward having higher postoperative mortality rates and had significantly higher rates of several complications than did patients with higher serum albumin levels, while controlling for other risk factors. Patients with hypoalbuminemia experienced a higher frequency of infective endocarditis, emergency surgery, transfusion of red blood cells, platelets and fresh frozen plasma, post-operative placement of intra-aortic balloon pumps, and gastrointestinal dysfunction, as well as significantly longer lengths of hospital stays, compared to patients with normal serum albumin.

Serum albumin level less than 3 g/dl was associated with increased post-operative morbidity and mortality according to studies done by Leite et al, Golub et al, Brown et al and Mullen et al. [2] According to Foley et al post-operative complication rate was higher when albumin was lower than 2.5 g/dl ($p<0.001$) According to Beghetto et al it was concluded that serum albumin level was the strongest predictive parameter for death and hospital infection (<3.5g/dl).

Engelman et al observed that albumin less than 2.5 g/dl ($p<0.001$) and BMI less than 20kg/m2 ($p<0.005$) and greater than 30 kg/ m2 ($p <0.005$) was associated with increase in post-operative complications.

The prognostic value of serum albumin also extends to critically ill patients. A low serum albumin concentration correlates with increased length of stay in the intensive care unit (ICU) and with complication rates, such as ventilator dependency and the development of new infection. The daily trend of serum albumin can be a useful tool in predicting the weaning capability of patients needing mechanical ventilation. Non-survivors of critical illness have lower serum albumin concentrations than survivors, In one study, non-survivors had lower serum albumin concentrations on admission to the ICU, and their albumin concentrations decreased more rapidly in the first 24±48 h.

In the present study, there is a stastically significant association between hematocrit and post operative complications. Calculation of p value using Pearson chi square test showed p value 0.005 which is statistically significant. However, t test on values of hematocrit shows no association with post operative complications (p value = 0.365). In the present study, no association was not found between ASA grades and post op complications.

The ASA classification is an assessment of the patient's pre-operative physical status. On its own, the ASA classification of physical status is not a predictor of operative risk. There are many examples of retrospective studies correlating ASA grading and postoperative mortality. The ASA classification has subsequently been successfully used to predict the risk of adverse surgical outcomes such as cardiorespiratory complications, intraoperative blood loss and duration of intensive-care stay.

Preoperative anemia has been shown to be a significant risk factor for mortality and morbidity in a wide variety of surgical procedures, and it has been shown to have an effect on length of stay in the colorectal and urologic surgery populations. The study, published in the June 13, 2007, issue of the Journal of the American Medical Association, was conducted by a group led by Dr Wen-Chih Wu (Providence Veterans Affairs Medical Center, RI). They explain that despite almost universal measurement of hematocrit values before major surgery, the prognostic implications of preoperative anemia or polycythemia are incompletely understood. Results showed that 30-day mortality

and cardiac-event rates increased with either positive or negative deviations from normal hematocrit levels.

Pre-operative assessment of seum albumin can be used both as a predictive factor for post operative morbidity and mortality and as prognostic parameter regarding overall survival in post operative period.

There is strong evidence of serum albumin in association with post-operative complications including surgical site infections, wound dehiscence, septicemia, prolonged hospital stay and even death in absence of any pre operative sepsis or any existing co morbidities.

There is a role of pre operative hematocrit as a risk predictor of surgical outcome, however no such association was found between pre op ASA grades and surgical outcome.

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